DIVISION 15

MECHANICAL SYSTEMS

SECTION 15900

BUILDING MANAGEMENT SYSTEM

1.   Part 1 – General

1.1   Scope of Work

Boiler System Scope of Work

Provide two new NCE's for control of the boiler system (B-1A, B-1B, P-2A, P-2B, and all associated boiler system points). One NCE shall control both boilers and the second NCE shall be a redundant hot back-up. The NCE's shall be programmed to operate as a redundant hot back-up so if one NCE fails the other NCE will automatically be brought on line to control the boilers. The new NCE's shall be connected to the existing Ethernet network and shall support one MS/TP Bus trunk. Add IOM's as required to capture remaining points.

All existing boiler system points connected to DDCP-3 shall be transferred to the new NCE's. Remove old AHU controllers and associated UNT controllers and relays after the boiler system controls (hardware, software, and programming) are commissioned. Controls modification shall only be completed on one boiler/pump at a time. The controls on the first boiler/pump worked on shall be fully operational and commissioned prior to working on the second boiler/pump. Replace the existing relays with new relays. Provide programming, sequence of operation and graphics to match the existing.

Chiller System Scope of Work

Provide two new NCE's for control of the chiller system (CH-100, CH-200, CH-300, CH-400, P-1A, P-1B, P-1C, P-1D, VFD-1 through 4, and all associated chiller system points). One NCE shall control each pair of chillers/pumps. The NCE's shall be programmed to operate as a redundant hot back-up so if one NCE fails the other NCE will automatically be brought on line to control it's associated pair of chillers/pumps. The new NCE's shall be connected to the existing Ethernet network and shall support one MS/TP Bus trunk. Add IOM's as required to capture remaining points.

All existing chiller system points connected to DDCP-1, DDCP-2, and DDCP-5 shall be transferred over to the new NCE's. Remove old AHU controllers and associated UNT controllers and relays after new NCE's are commissioned. Controls modification shall only be done to one chiller/pump system at a time. The controls on the first chiller/pump system worked on shall be fully operational and commissioned prior to working on the second

chiller/pump system. Replace the existing relays with new relays. Provide programming, sequence of operation and graphics to match the existing.

The cooling tower control system shall remain unchanged on existing controllers and control panels.

General

Provide programming, sequence of operation and graphics to match the existing. The existing boiler and chiller control systems shall be backed-up prior to any new work. The sequence of operation for the boilers and chillers shall be optimized to simplify lead, lag, and backup systems and shall be fully automated. The sequence of operation shall be coordinated with on-site FAA personnel. The boiler sequence of operation shall be modified to remove existing boiler 1C. The graphics shall be updated to display the new equipment with the old equipment removed. Furnish and install new panels for all new equipment that cannot fit into existing panels. Provide all electrical work to supply power to new equipment. Refer to JCI project number 9086-6361 for reference, existing points, sequence and additional information.

All N2 controllers removed on this project shall be protected from damage and turned over to the FAA.

Provide complete Metasys extended architecture for entire facility (Administration Wing, Automation Wing, Control Wing, Power Service Building, and NEMC Building) as part of as-built drawings. Extended architecture shall display all operator workstations, servers, communication interfaces, direct digital control panels, supervisory interfaces, and controllers along with designation numbers and communication protocol. Model numbers shall also be included (example: DX9100, NAE35, etc.).

Provide training and warranty as specified herein.

1.2   **Related Documents**

A.   All work of this Division shall be coordinated and provided by the manufacturers local factory owned Salt Lake branch office of Johnson Controls as an extension to the existing Metasys DDC system.

B.   The work of this Division shall be scheduled, coordinated, and interfaced with the associated work of other trades.

C.   The work of this Division shall be as required by the Specifications, Point Schedules. If the BMS Contractor believes there are conflicts or missing information in the project documents, the Contractor shall promptly request clarification and instruction from the design team.

1.3   **Air Traffic Control Equipment Restrictions**

A.   Job Conditions: Do not permit interference with the air traffic control function at the Center. Schedule and plan work to permit normal facility operations to continue with minimum of disruption. Access to the facility shall be kept unobstructed at all times. If interference with the existing facility operations seems to be unavoidable, advise the COR 24 hours prior to such interference. Proceed as directed by the COR.

B.   Equipment Shutdown: Each ARTCC maintains air traffic control continuously without shutdown. Various techniques are employed to achieve maximum system availability. Mechanical and electrical systems in direct support of air traffic operation and environmental systems have redundant configurations. Shutdown of equipment shall be scheduled with the COR at least 24 hours prior to the DDCP installer's need. The reliability of mechanical and electrical systems is compromised when redundant equipment is not available. Every effort will be made by the FAA to allow work to be accomplished during the installer's normal working hours; however, the COR may require that certain equipment be shut down during off normal hours and be restored to service immediately after this period. Shutdown shall be accomplished by FAA personnel.

1.4   MS Description

A.   The Building Management System (BMS) shall be a complete system designed to integrate with the existing BMS network. This functionality shall extend into the equipment rooms. Devices residing on the network located in equipment rooms and similar shall be fully IT compatible devices that mount and communicate directly on the IT infrastructure in the facility. Contractor shall be responsible for coordination with the owner's IT staff to ensure that the BMS will perform in the owner's environment without disruption to any of the other activities taking place on that LAN. FAA shall provide the I/P connections for the new NCE's.

B.   All points of user interface shall be on the existing PCs that do not require the purchase of any special software from the BMS manufacturer for use as a building operations terminal. The primary point of interface on these PCs will be a standard Web Browser.

C.   The BMS work shall consist of the provision of all labor, materials, tools, equipment, software, software licenses, software configurations and database entries, interfaces, wiring, tubing, installation, labeling, engineering, calibration, documentation, samples, submittals, testing, commissioning, training services, permits and licenses, transportation, shipping, handling, administration, supervision, management, insurance, temporary protection, cleaning, cutting and patching, warranties, services, and items, even though these may not be specifically mentioned in these Division documents which are required for the complete, fully functional and commissioned BMS.

D.   Manage and coordinate the BMS work in a timely manner in consideration of the Project schedules. Coordinate with the associated work of other trades so as to not impede or delay the work of associated trades.

E.   The BMS as provided shall incorporate, at minimum, the following integrated features, functions and services:

    1.   Operator information, alarm management and control functions.

    2.   Enterprise-level information and control access.

    3.   Information management including monitoring, transmission, archiving, retrieval, and reporting functions.

    4.   Diagnostic monitoring and reporting of BMS functions.

    5.   Offsite monitoring and management access.

      6.   Energy management

1.5 Quality Assurance

A. General

    1.   The Building Management System Contractor shall be the primary manufacturer-owned local Salt Lake branch office of Johnson Controls, Inc. that is regularly engaged in the engineering, programming, installation and service of total integrated Building Management Systems.

B. Quality Management Program

    1.   Designate a competent and experienced employee to provide BMS Project Management. The designated Project Manger shall be empowered to make technical, scheduling and related decisions on behalf of the BMS Contractor. At minimum, the Project Manager shall:

        a.   Manage the scheduling of the work to ensure that adequate materials, labor and other resources are available as needed.

        b.   Manage the financial aspects of the BMS Contract.

        c.   Coordinate as necessary with other trades.

        d.   Be responsible for the work and actions of the BMS workforce on site.

C. Installer and Manufacturer Qualifications

    1.   Installer shall be a certified installer/technician of the Control System Manufacturer with a minimum of 2 years experience installing systems of similar type, size and complexity.

    2.   Installer shall have successfully completed Control System Manufacturer's control system training. Upon request, Installer shall present record of completed training including course outlines.

1.6 Submittals

A. Product Submittal Requirements: Meet requirements of Section 01300 on Shop Drawings, Product Data, and Samples. Provide six copies of shop drawings and other submittals on hardware, software, and equipment to be installed or furnished. Begin no work until submittals have been approved for conformity with design intent. Provide drawings as AutoCAD 2006 (or newer) compatible files on compact disc (file format: .DWG or .DGN) and 3 prints of each drawing on 11" x 17" paper. When manufacturer's cutsheets apply to a product series rather than a specific product, clearly indicate applicable data by highlighting or by other means. Clearly reference covered specification and drawing on each submittal. General catalogs shall not be accepted as cutsheets to fulfill submittal requirements. Select and show submittal quantities appropriate to scope of work. Submittal approval does not relieve Contractor of responsibility to supply sufficient quantities to complete work. Provide submittals on the following:

    1.   Direct Digital Control System Hardware

        a.   Complete bill of materials indicating quantity, manufacturer, model number, and relevant technical data of equipment to be used.

        b.   Manufacturer's description and technical data such as performance curves, product specifications, and installation and maintenance instructions.

        c.   Wiring diagrams and layouts for each control panel. Show termination numbers.

        d.   Floor plan schematic diagrams indicating field sensor and controller locations.

        e.   Riser diagrams showing control network layout, communication protocol, and wire types.

2.   Controlled Systems

        a.   Riser diagrams showing control network layout, communication protocol, and wire types.

        b.   Schematic diagram of each controlled system. Label control points with point names. Graphically show locations of control elements.

        c.   Schematic wiring diagram of each controlled system. Label control elements and terminals. Where a control element is also shown on control system schematic, use the same name.

        d.   Instrumentation list (Bill of Materials) for each controlled system. List each control system element in a table. Show element name, type of device, manufacturer, model number, and product data sheet number.

B.   Schedules

    1.   Schedule of work provided within one month of contract award, indicating:

        a.   Intended sequence of work items

        b.   Start date of each work item

        c.   Duration of each work item

        d.   Planned delivery dates for ordered material and equipment and expected lead times

        e.   Milestones indicating possible restraints on work by other trades or situations

    2.   Monthly written status reports indicating work completed and revisions to expected delivery dates. Include updated schedule of work.

C.   Project Record Documents. Submit three copies of record (as-built) documents upon completion of installation for approval prior to final completion. Submittal shall consist of:

    1.   Project Record Drawings. As-built versions of submittal shop drawings provided as AutoCAD 2006 (or newer) compatible files on compact disc (file format: .DWG, .DGN, or comparable) and 6 prints of each drawing on 11" x 17" paper.

    2.   Testing and Commissioning Reports and Checklists. Completed versions of reports, checklists, and trend logs used to meet requirements of Section 15900 Article 3.17 (Control System Demonstration and Acceptance).

    3.   Operation and Maintenance (O&M) Manual. Printed, electronic, or online help documentation of the following:

        a.   As-built versions of submittal product data.

        b.   Names, addresses, and telephone numbers of installing contractors and service representatives for equipment and control systems.

        c.   Operator's manual with procedures for operating control systems: logging on and off, handling alarms, producing point reports, trending data, overriding computer control, and changing setpoints and variables.

        d.   Programming manual or set of manuals with description of programming language and syntax, of statements for algorithms and calculations used, of

          point database creation and modification, of program creation and modification, and of editor use.

    e.   Engineering, installation, and maintenance manual or set of manuals that explains how to design and install new points, panels, and other hardware; how to perform preventive maintenance and calibration; how to debug hardware problems; and how to repair or replace hardware.

    f.   Documentation of programs created using custom programming language including setpoints, tuning parameters, and object database. Electronic copies of programs shall meet this requirement if control logic, setpoints, tuning parameters, and objects can be viewed using furnished programming tools.

    g.   Graphic files, programs, and database on magnetic or optical media.

    h.   List of recommended spare parts with part numbers and suppliers.

    i.   Complete original-issue documentation, installation, and maintenance information for furnished third-party hardware including computer equipment and sensors.

    j.   Complete original-issue copies of furnished software, including operating systems, custom programming language, operator workstation or web server software, and graphics software.

    k.   Licenses, guarantees, and warranty documents for equipment and systems.

    l.   Recommended preventive maintenance procedures for system components, including schedule of tasks such as inspection, cleaning, and calibration; time between tasks; and task descriptions.

D.   Training Materials: Provide training outline and materials for each session covering new controls equipment and components installed on this project. Training shall be furnished via instructor-led sessions, computer-based training, or on-site training. Engineer will modify training outlines and materials if necessary to meet Owner's needs. Engineer will review and approve training outlines and materials at least three weeks before first training session.

1.7   Warranty

A.   Standard Material and Labor Warranty:

    1.   Provide a one-year labor and material warranty on the BMS.

    2.   If within twelve (12) months from the date of acceptance of product, upon written notice from the owner, it is found to be defective in operation, workmanship or materials, it shall be replaced, repaired or adjusted at the option of the BMS Contractor at the cost of the BMS Contractor.

    3.   Maintain an adequate supply of materials within 100 miles of the Project site such that replacement of key parts and labor support, including programming. Warranty work shall be done during BMS Contractor's normal business hours.

1.8   Ownership of Proprietary Material

A.   Project-specific software and documentation shall become Owner's property. This includes, but is not limited to:

    1.   Graphics

    2.   Record drawings

3.   Database

4.   Application programming code

5.   Documentation

2.   Part 2 – Products

2.1   General Description

A.   The Building Management System (BMS) shall use an open architecture and fully support a multi-vendor environment. To accomplish this effectively, the BMS shall support open communication protocol standards and integrate a wide variety of third-party devices and applications. The system shall be designed for use on the Internet, or intranets using off the shelf, industry standard technology compatible with other owner provided networks.

B.   The system shall be modular in nature, and shall permit expansion of both capacity and functionality through the addition of sensors, actuators, controllers and operator devices, while re-using existing controls equipment.

C.   System architectural design shall eliminate dependence upon any single device for alarm reporting and control execution.

    1.   The failure of any single component or network connection shall not interrupt the execution of control strategies at other operational devices.

    2.   The System shall maintain all settings and overrides through a system reboot.

D.   Acceptable Manufacturers

    1)   Johnson Controls, Metasys

2.2   BMS Architecture

A.   Control Network

    1.   Provide Johnson Controls Network Control Engines model# MS-NCE 2560-0 to provide control of the existing boilers and chillers and integrate into the existing control network through new I/P connections provided by FAA.

    2.   NCE's shall support MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9. The NCE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label. The NCE shall be tested and certified as a BACnet Building Controller (B-BC).

2.3   User Interface

A.   Dedicated Web Based User Interface

    1.   The existing web server and operator workstations shall be utilized for this project

    2.   The new NCE controllers shall be integrated into the existing hardware and software to provide a fully functional system with the same features, functions, programs and graphic displays to match the existing system including all commands, schedules, reports, alarms, trends, displays and applications.

    3.   BMS contractor shall provide Metasys software revision upgrades to the existing server and laptop as required for communication to the new NCE's.

    4.   Server hardware and operating system upgrades shall be responsibility of FAA.

    5.   The operation of the control system shall be independent of the existing user interface, which shall be used for operator communications only.

2.4   Network Control Engine   (JCI Model# MS- NCE 2560-0)

1. The Network Control Engines (NCE) shall be a fully user-programmable, supervisory controller. The NCE shall monitor the network of distributed application-specific controllers, provide global strategy and direction, and communicate on a peer-to-peer basis with other NAE's and NCE's.

2. The Network Control Engine (NCE) shall be a fully user-programmable, digital controller that includes a minimum of 32 I/O points.

3. The NCE shall reside on the I/P network and shall support a subnet of 32 Field controllers.

4. User Interface – Each NCE shall have the ability to deliver a web based User Interface (UI) as previously described. All computers connected physically or virtually to the I/P network shall have access to the web based UI.

    a. The web based UI software shall be imbedded in the NCE

    b. The NCE shall have the capability of generating web based UI graphics. The graphics capability shall be imbedded in the NCE.

    c. The NCE shall allow temporary use of portable devices without interrupting the normal operation of permanently connected modems.

5. The NCE shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

6. The NCE shall support the following number and types of inputs and outputs:

    a. Ten Universal Inputs

    b. Eight Binary Inputs

    c. Four Analog Outputs

    d. Seven Binary Outputs

    e. Four Configurable Outputs

7. The NCE shall have the ability to monitor and control a network of sensors and actuators over a Sensor-Actuator Bus (SA Bus).

8. The NCE shall have the capability to execute complex control sequences involving direct wired I/O points as well as input and output devices communicating over the Field Trunk or the SA Bus.

9. Each NCE shall have sufficient memory to support its own operating system, databases, and control programs, and to provide supervisory control for all control level devices.

10. The NCE shall include an integrated, hardware-based, real-time clock.

11. The NCE shall employ nonvolatile Flash memory to store all programs and data. The NCE shall employ a data protection battery to save data and power the real time clock when primary power is interrupted.

12. The NCE shall include troubleshooting LED indicators

13. Diagnostics – The NCE shall continuously perform self-diagnostics, communication diagnosis, and diagnosis of all panel components. The Network Control Engine shall provide both local and remote annunciation of any detected component failures, low battery conditions, or repeated failures to establish communication.

14. Power Failure – In the event of the loss of normal power, The NCE shall continue to operate for a user adjustable period of up to 10 minutes after which there shall

be an orderly shutdown of all programs to prevent the loss of database or operating system software.

    a. During a loss of normal power, the control sequences shall go to the normal system shutdown conditions. All critical configuration data shall be saved into Flash memory.

    b. Upon restoration of normal power and after a minimum off-time delay, the controller shall automatically resume full operation without manual intervention through a normal soft-start sequence.

15. Certification – The NCE shall be listed by Underwriters Laboratories (UL).File E107041, CCN PAZX, UL 916, Energy Management Equipment. FCC Compliant to CFR47, Part 15, Subpart B, Class A

16. Field Controller Bus –

    a. The NCE shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

       ◊ The NCE shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

       ◊ The NCE shall be tested and certified as a BACnet Building Controller (B-BC).

2.5 DDC System Controllers

A. Input/output Module **(JCI Model# IOM 4711-0)**

1. The Input/Output Module (IOM) provides additional inputs and outputs for use in the FEC and NCE

2. The IOM shall communicate with the FEC or NCE over the FC Bus or the SA Bus.

3. The IOM shall support BACnet Standard MS/TP Bus Protocol ASHRAE SSPC-135, Clause 9 on the controller network.

    a. The IOM shall be BACnet Testing Labs (BTL) certified and carry the BTL Label.

    b. The IOM shall be tested and certified as a BACnet Application Specific Controller (B-ASC).

    c. A BACnet Protocol Implementation Conformance Statement shall be provided for the FEC.

4. The IOM shall be assembled in a plenum-rated plastic housing with flammability rated to UL94-5VB.

2.6 Input Devices

A. Control Relays

1. Control Pilot Relays

    a. Control pilot relays shall be of a modular plug-in design with retaining springs or clips.

    b. Mounting Bases shall be snap-mount.

    c. DPDT, 3PDT, or 4PDT relays shall be provided, as appropriate for application.

    d. Contacts shall be rated for 10 amps at 120VAC.

    e. Relays shall have an integral indicator light and check button.

    f. Acceptable manufacturers: Johnson Controls, Lectro

2.7 Miscellaneous Devices

A.   Local Control Panels

1.   All control panels shall be factory constructed, incorporating the BMS manufacturer's standard designs and layouts. All control panels shall be UL inspected and listed as an assembly and carry a UL 508 label listing compliance. Control panels shall be fully enclosed, with perforated sub-panel, hinged door, and slotted flush latch.

2.   In general, the control panels shall consist of the DDC controller(s), display module as specified and indicated on the plans, and I/O devices—such as relays, transducers, and so forth—that are not required to be located external to the control panel due to function. Where specified the display module shall be flush mounted in the panel face unless otherwise noted.

3.   All I/O connections on the DDC controller shall be provide via removable or fixed screw terminals.

4.   Low and line voltage wiring shall be segregated. All provided terminal strips and wiring shall be UL listed, 300-volt service and provide adequate clearance for field wiring.

5.   All wiring shall be neatly installed in plastic trays or tie-wrapped.

6.   A 120 volt convenience outlet, fused on/off power switch, and required transformers shall be provided in each enclosure.

B.   Power Supplies

1.   DC power supplies shall be sized for the connected device load. Total rated load shall not exceed 75% of the rated capacity of the power supply.

2.   Input: 120 VAC +10%, 60Hz.

3.   Output: 24 VDC.

4.   Line Regulation: +0.05% for 10% line change.

5.   Load Regulation: +0.05% for 50% load change.

6.   Ripple and Noise: 1 mV rms, 5 mV peak to peak.

7.   An appropriately sized fuse and fuse block shall be provided and located next to the power supply.

8.   A power disconnect switch shall be provided next to the power supply.

3.   Part 3 – Performance / Execution

3.1   BMS Specific Requirements

A.   Graphic Displays

1.   Provide a color graphic system flow diagram display for each system with all points as indicated on the point list. All terminal unit graphic displays shall be from a standard design library.

2.   User shall access the various system schematics via a graphical penetration scheme and/or menu selection.

3.2   Installation Practices

A.   BMS Wiring

1.   All conduit, wiring, accessories and wiring connections required for the installation of the Building Management System, as herein specified, shall be provided by the BMS Contractor. All wiring shall comply with the requirements of applicable portions of Division 16 and all local and national electric codes, unless specified otherwise in this section.

2.   All BMS wiring materials and installation methods shall comply with BMS manufacturer recommendations and Division 16.

3.   The sizing, type and provision of cable, conduit, cable trays, and raceways shall be the design responsibility of the BMS Contractor.

4.   Wiring

   a.   All wiring shall be installed in conduit in accordance with Division 16.

5.   Provide for complete grounding of all applicable signal and communications cables, panels and equipment so as to ensure system integrity of operation. Ground cabling and conduit at the panel terminations. Avoid grounding loops.

B.   BMS Line Voltage Power Source

1.   120-volt AC circuits used for the Building Management System shall be taken from existing panel boards and circuit breakers. The BMS Contractor shall provide power to new equipment using existing panel boards and circuit breakers. The BMS Contractor shall coordinate with FAA personnel on power supply source.

2.   Circuits used for the BMS shall be dedicated to the BMS and shall not be used for any other purposes.

C.   BMS Raceway

1.   All wiring shall be installed in conduit in accordance with Division 16. Minimum control wiring conduit size 3/4".

2.   Where it is not possible to conceal raceways in finished locations, surface raceway (Wiremold) may be used as approved by the Architect.

3.   All conduits and raceways shall be installed level, plumb, at right angles to the building lines and shall follow the contours of the surface to which they are attached.

D.   Penetrations

1.   Provide fire stopping for all penetrations used by dedicated BMS conduits and raceways.

2.   All openings in fire proofed or fire stopped components shall be closed by using approved fire resistive sealant.

3.   All wiring passing through penetrations, including walls shall be in conduit or enclosed raceway.

4.   Penetrations of floor slabs shall be by core drilling. All penetrations shall be plumb, true, and square.

E.   BMS Identification Standards

   Node Identification. All nodes shall be identified by a permanent label fastened to the enclosure. Labels shall be suitable for the node location. Install all labels and identification in accordance with Division 16.

F.   BMS Panel Installation

1.   The BMS panels and cabinets shall be located as indicated at an elevation of not less than 2 feet from the bottom edge of the panel to the finished floor. Each cabinet shall be anchored per the manufacturer's recommendations.

2.   The BMS contractor shall be responsible for coordinating panel locations with other trades and electrical and mechanical contractors.

G.   HVAC Output Devices

1.   Electronic Signal Isolation Transducers: Whenever an analog output signal from the Building Management System is to be connected to an external control system as an input (such as a chiller control panel), or is to receive as an input a signal from a remote system, provide a signal isolation transducer. Signal isolation transducer shall provide ground plane isolation between systems. Signals shall provide optical isolation between systems

3.3   Training

A.   The BMS contractor shall provide the following training services:

1.   A total of 16 hours of on-site training shall be provided by a system technician who is fully knowledgeable of the specific installation and programming details of the project. Each training session shall be a minimum of 4 hours. This training shall, at a minimum, consist of a review of the project as-built drawings, the BMS software layout and naming conventions, review of system operation, programming modifications and a walk through of the facility to identify panel and device locations.

3.4   Commissioning

A.   Fully commission all aspects of the Building Management System work.

B.   Acceptance Check Sheet

1.   Prepare a check sheet that includes all points for all functions of the BMS as indicated on the point list included in this specification.

2.   Submit the check sheet to the Engineer for approval

3.   The Engineer will use the check sheet as the basis for acceptance with the BMS Contractor.

C.   Promptly rectify all listed deficiencies and submit to the Engineer that this has been done.

3.5   Sequences

A.   See "1.1 Scope of Work" above.